FINAL REPORT

EXECUTIVE SUMMARY

ENERGY SAVINGS OPPORTUNITY SURVEY

RED RIVER ARMY DEPOT, TEXAS

March, 1988

Prepared for:

UNITED STATES ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
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RED RIVER ARMY DEPOT
ENERGY SAVINGS OPPORTUNITY SURVEY
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Introduction

The objectives of this study are threefold:

1. To determine the feasibility of twelve designated Energy Conservation Opportunities (ECO's) on specified buildings

2. To provide programming documentation for qualifying projects

3. To determine the availability and cost of waste wood products within a fifty mile radius of the Depot. The wood products must be suitable for use as boiler fuel in the central heating plant in Building 336.

The short title and applicable buildings of each ECO are given in Table ES.1.

TABLE ES.1

ECO DEFINITION

ECO	SHORT TITLE	BUILDING NOS.
1	Pelletize waste paper for boiler fuel	336
2	Pelletize waste wood products for boiler fuel	336
3	Burn waste oil in boilers	186, 638, 651, 676
4	Replace existing boilers with high efficiency units	186, 638, 651, 676
5	Extend the EMCS	312, 333, 493
6	Extend the EMCS to control dehumidifiers	551, 594
7	Window retrofit study	15, 110, 112
8	Destratification fans	594, 595
9	Automatic door openers	321, 333, 345, 373, 401, 411, 493
10	Extend steam lines and eliminate use of boilers	468, 594, 595

TABLE ES.1 (Con't)

11	Two-speed paint booth ventilation systems	323, 333, 357, 360
12	Heat recovery on processes with exhaust and makeup air	323, 333, 357, 360, 493

There were no reevaluations of ECOs designated in this study.

The discrete portions of each ECO were analyzed independently (building, paint booth, curing oven, etc.) in accordance with Energy Conservation Investment Program guidance dated June 11, 1986. The unqualifying discrete portions of each ECO were then removed from consideration, and a final evaluation was made taking synergism into account. Those ECO's that qualified in the second evaluation with SIR greater than one and simple payback less than 10 years were assigned to programs for implementation. The programming documentation was completed.

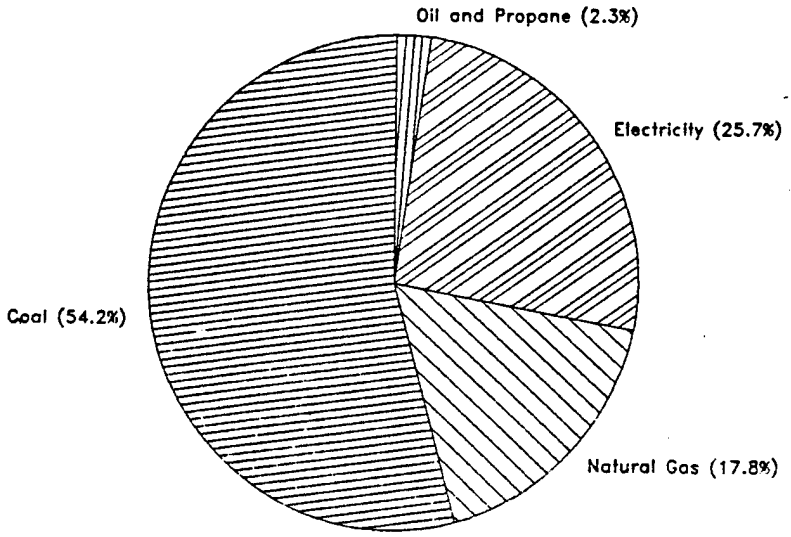
FY86 Energy Consumption and Unit Fuel Prices

The annual gross consumption of energy at the Depot has grown over the years as the Depot has become larger and processes have become more energy intensive. The historical consumption data for FY86 is the last set of complete data available at the beginning of this study. The twelve ECO's affect the consumption of coal, electricity, natural gas and No. 2 oil. Historical consumption and unit price data used in this analysis are shown in the following table:

Energy Type	FY86 Gross Consumption (MBTU)		Unit Price ($/MBTU)	Annual Cost ($1000)
Coal	423,225	(54.2%)	2.75	1,164
Natural Gas	139,100	(17.8%)	4.27	594
Electricity	200,394	(25.7%)	11.40*	2,284
No. 2 Oil	15,350	(2.0%)	5.74	88
Propane	2,576	(0.3%)	7.79	20

* Includes all electric utility charges

where MBTU is Millions of British Thermal Units. The FY86 unit electric demand charge is $5.01 per Kilowatt (KW).



The low unit price for coal reflects the use of a mixture of coal and dry wood chips as boiler fuel in Building 336. The wood chips are made from scrap pallets and dry lumber from on-depot, and are free. Currently all of the available waste wood from on-depot is burned in the central heating plant. The current fuel mix by heat content is 10.9 percent wood and 89.1 percent coal and the FY86 unit price for boiler fuel is $2.45/MBTU.

Fifty Mile Radius Wood Product Survey

A survey was conducted to determine the availability and cost of wood chips, shavings and sawdust within a fifty mile radius of the depot, which encompasses four states: Texas, Arkansas, Oklahoma and Louisiana. There is a very active market for waste wood products in this area, as other steam plants purchase wood for use as boiler fuel, and manufacturers of wood products also purchase chips and sawdust for use in making particle board and various types of wall board. The price of delivered chips ranges from $8.00 to as high as $25.00 per ton, and depends upon quality and transport distance. Producers of waste wood products currently sell all they produce, so that a seller's market exists. The prevailing price for wood products suitable for use as boiler fuel is $10.00 per ton delivered. The average moisture content is 50% by weight, and the average heat content is 4,300 BTU per pound. The energy required to dry a pound of wood to 10 percent moisture content is 1,644 BTU.

In summary, ample green wood chips and shavings are available from the local area at approximately $10.00 per ton delivered. The wood must be dried for use as a boiler fuel, which may be done in the boiler or in a separate dryer.

ECO Evaluation Results

In the independent evaluation of the ECO's, nine qualified on one or more buildings with Savings-to-Investment Ratios (SIR's) greater than one and simple paybacks of ten years or less. The results for all ECO's are listed in Table ES.2.

Nonqualifying ECO's:

The three nonqualifying ECO's are ECO 2, Wood Pelletizer, ECO 3, Burn Waste Oil, and ECO 6, EMCS Control of Dehumidifiers.

The wood pelletizer failed to qualify because of the high construction cost. The substantial reduction in coal costs were partially offset by the increased costs in maintenance, electricity, and the purchase of the wood chips. The additional costs coupled with the high construction cost defeated the ECO.

ECO 3, Burn Waste Oil, fails to qualify for two reasons: 1) the high construction cost imposed by a requirement to install new, dual fuel burners to handle both natural gas and waste oil, as well as the requirement to install an oil storage tank at each boiler house, and 2) the high cost of daily maintenance. The existing burners will not handle both natuaral gas and waste oil, and new replacement burners will require that the waste oil be thoroughly filtered. The filters will have to be serviced daily. The savings from reduced natural gas consumption are insufficient to overcome these high costs.

ECO 6, EMCS Dehumidifier Control, has application only to building 551, and then only for demand limiting control. On the field survey it was determined that Building 594 already has EMCS control of the humidifiers, as do buildings 582 and 592. In these three buildings it has not proven practical to shut off the dehumidifiers when overhead doors are open. The only practical use of the EMCS has proven to be demand limiting control. The annual savings from demand limiting control of the dehumidifiers in 551 are insufficient to carry the construction cost.

ECO's 11 and 12 depend on thermal energy savings for the most part, and only discrete portions qualify--- those applications for which there is a three shift schedule. The problem is two-fold: 1) the temperature of the exhaust air, and 2) the number of hours per day that the processes are in operation. Winters are relatively mild at the depot, and for ECO's to qualify on heat recovery it is necessary to have high exhaust air temperatures, such as in paint curing ovens, and three shift operation. Those applications for which the exhaust air temperature is essentially at room temperature (paint and welding

booths) and that operate on one and two shift daily schedules do not, in general, qualify.

Table ES.2

Summary of Results and Recommendations - Without Synergism, Ranked by SIR

ECO #	ECO Short Title	Discrete Portion	Annual Savings / (Costs or Use) Energy (MBTU) Coal	Wood	Nat. Gas	Elec.	Other	Non-energy ($)	Net ($)	Const. Cost ($1000)	SPB (yrs)	SIR
9	Automatic Door Openers	#411	104	13	0	0	0	960	1,245	0.7	0.6	20.1
		#321	231	28	0	0	0	3,222	3,856	2.3	0.6	19.8
		#333	377	46	0	0	0	3,239	4,276	3.6	0.9	14.2
		#493	142	17	0	0	0	1,727	2,117	1.8	0.9	14.1
4	Replace Boilers	#186	0	0	2,819	(100)	0	0	10,897	21.1	1.9	11.0
		#638	0	0	1,201	0	0	0	5,128	16.9	3.3	6.2
10	Extend Steam Lines	#468	(6,366)	(779)	8,003	(1)	0	0	16,655	81.3	4.9	5.7
		#594,595	(33,446)	(4,092)	39,946	(10)	0	0	78,479	400.8	5.1	5.6
4	Replace Boilers	#651	0	0	1,081	0	0	0	4,616	19.1	4.1	5.0
9	Automatic Door Openers	#373	31	4	0	0	0	493	579	1.8	3.1	3.8
		#345	168	21	0	0	0	1,921	2,383	7.8	3.3	3.7
1	Pelletize Paper	Total	225,225	0	0	(5,092)	-Paper- (225,225)	(32,137)	529,183	2,005.2	3.8	3.7
4	Replace Boilers	#676	0	0	0	0	-#2 Oil- 780	0	4,477	24.2	5.4	3.1
8	Destratification Fans	#595	0	0	2,433	(147)	0	(1,419)	7,291	66.2	9.1	2.6
		#594	0	0	2,415	(147)	0	(1,419)	7,217	66.2	9.2	2.6
7	Glazing Study											
	Insulated Panels	#15	0	0	119	31	0	0	862	6.8	7.9	2.2
		#110	0	0	260	52	0	0	1,703	15.9	9.4	1.9
12	Heat Recovery	#323N	13,882	1,698	0	(1,362)	0	(484)	22,165	163.4	7.4	1.9

Table ES.2 (con't)

Summary of Results and Recommendations - Without Synergism, Ranked by SIR

ECO #	ECO Short Title	Discrete Portion	Annual Savings / (Costs or Use) Energy (MBTU) Coal	Wood	Nat. Gas	Elec.	Other	Non-energy ($)	Net ($)	Const. Cost ($1000)	SPB (yrs)	SIR
7	Glazing Study Insulated Panels	#112	0	0	322	3	0	0	1,409	15.9	11.3	1.8
11	Paint Booth	#323N	1,297	159	0	852	0	(484)	12,796	102.8	8.1	1.7
	Ventilation	#357	303	37	0	69	0	(121)	1,492	13.9	9.3	1.5
	Control	#360	303	37	0	69	0	(121)	1,492	13.9	9.3	1.5
5	Extend EMCS Dedicated DTM	#312,333	0	0	0	1,556	0	0	17,083	122.6	7.2	1.4
12	Heat Recovery	#333	1,487	182	0	(48)	0	(484)	3,058	30.7	10.0	1.4
2	Pelletize Wood	Total	336,872	(408,749)	0	(12,221)	0	(45,300)	267,630	4,177.6	15.7	1.1
12	Heat Recovery	#357	1871	229	0	(222)	0	(121)	2,489	26.9	14.0	1.0
		#360	1871	229	0	(222)	0	(121)	2,489	26.9	14.0	1.0
7	Glazing Study Inside Storm	#112	0	0	594	4	0	0	2,582	65.4	25.4	0.8
	Fixed Double Pane	#112	0	0	71	4	0	0	349	9.8	28.1	0.7
	Inside Storm	#15	0	0	195	12	0	0	969	30.4	31.5	0.6
		#110	0	0	389	21	0	0	1,900	66.4	35.0	0.6
	Fixed Double Pane	#15	0	0	216	13	0	0	1,071	39.0	36.6	0.5
		#110	0	0	422	22	0	0	2,053	87.4	42.7	0.5
	Moving Double Pane	#112	0	0	369	3	0	0	1,610	71.5	44.6	0.5

Table ES.2 (con't)

Summary of Results and Recommendations - Without Synergism, Ranked by SIR

ECO #	ECO Short Title	Discrete Portion	Annual Savings / (Costs or Use) Energy (MBTU) Coal	Wood	Nat. Gas	Elec.	Other	Non-energy ($)	Net ($)	Const. Cost ($1000)	SPB (yrs)	SIR
7	Glazing Study Reflective Film	#112	0	0	81	11	0	0	471	16.8	35.7	0.5
		#15	0	0	244	38	0	0	1,475	67.8	46.1	0.4
		#110	0	0	507	64	0	0	2,894	150.3	52.1	0.4
	Moving Double Pane	#15	0	0	114	10	0	0	601	33.3	55.6	0.3
		#110	0	0	235	16	0	0	1,186	72.6	61.4	0.3
	Shade Screen	#110	0	0	(29)	35	0	0	275	55.7	>100	0.1
		#112	0	0	(12)	13	0	0	97	9.9	>100	0.1
6	EMCS Dehumidifier Control	#551	0	0	0	0	0	170	170	15.5	91.5	0.1
7	Glazing Study Shade Screen	#15	0	0	(28)	25	0	0	165	30.5	>100	0.0
5	Extend EMCS Dedicated DTM	#493	0	0	0	0	0	13	13	17.8	>100	0.0
3	Reclaim Waste Oil						-Wst.Oil-					
		#186	0	0	2,885	(22)	(2,885)	(6,512)	(3,474)	18.9	N/A	N/A
		#638	0	0	1,246	(20)	(1,246)	(4,669)	(3,725)	18.9	N/A	N/A
		#651	0	0	1,405	(20)	(1,405)	(4,669)	(3,295)	18.9	N/A	N/A
		#676	0	0	0	(20)	(1,392)	(4,669)	(1,264)	18.9	N/A	N/A
							-#2 Oil- 1,392					

The qualifying ECO's from the first analysis were then reevaluated to determine the effects of synergism on ECO qualification. The results are presented in Table ES.3. Note that ECO 1, the paper pelletizer, provides a large coal savings of 225,225 MBTU per year. ECO 1 is very effective since the entire steam load on the central heating plant benefits by the 40 % reduction in boiler fuel cost that results from burning free paper. ECO 10, extension of the steam lines, also benefits from the reduction in steam cost, as the use of paper in the boiler plant is more cost effective than the use of coal. On the other hand, those ECO's that rely on steam savings from Building 336 for qualification are negatively impacted by reducing the unit steam cost. ECO 8, destratification fans in buildings 594 and 595, no longer qualifies with the reduced value of thermal energy savings. The same is true for ECO 12, heat recovery from processes. Both of these ECO's qualified marginally under the ECIP guidance without the effects of synergism.

Table ES.3

Summary of Results and Recommendations - With Synergism, Ranked by SIR

ECO #	ECO Short Title	Discrete Portion	Annual Savings / (Costs or Use) Energy (MBTU) Coal	Wood	Nat. Gas	Elec.	Other	Non-energy ($)	Net ($)	Const. Cost ($1000)	SPB (yrs)	SIR	Recom.
9	Automatic Door Openers	Total	547	635	0	0	0	11,562	13,067	18.1	1.4	8.5	FEP
10	Extend Steam Lines	Total	(20,688)	(23,995)	47,949	(11)	0	0	147,725	482.1	3.3	7.1	ECIP
4	Replace Boilers	Total	0	0	5,101	(100)	780	0	25,118	81.3	3.2	6.2	PECIP
1	Pelletize Paper	Total	225,225	0	0	(5,092)	-Paper- (225,225)	(32,137)	529,183	2,005.2	3.8	3.7	ECIP
7	Glazing Study Insulated Panels	Total	0	0	379	83	0	0	2,565	22.7	8.9	2.0	FEP
	Insulated Panels	#112	0	0	322	3	0	0	1,409	15.9	11.3	1.8	Reject
11	Paint Booth Ventilation Control	#323N	674	782	0	852	0	(484)	11,083	102.8	9.3	1.5	FEP
5	Extend EMCS Dedicated DTM	#312,333	0	0	0	1,556	0	0	17,083	122.6	7.2	1.4	FEP
2	Pelletize Wood	Total	336,872	(408,749)	0	(12,221)	0	(45,300)	267,630	4,177.6	15.7	1.1	Reject
11	Paint Booth Ventilation Control	#357	157	182	0	69	0	(121)	1,092	13.9	12.8	1.1	Reject
		#360	157	182	0	69	0	(121)	1,092	13.9	12.8	1.1	

Table ES.3 (con't)

Summary of Results and Recommendations - With Synergism, Ranked by SIR

ECO #	ECO Short Title	Discrete Portion	Annual Savings / (Costs or Use) Energy (MBTU) Coal	Wood	Nat. Gas	Elec.	Other	Non-energy ($)	Net ($)	Const. Cost ($1000)	SPB (yrs)	SIR	Recom.
7	Glazing Study Inside Storm	#112	0	0	594	4	0	0	2,582	65.4	25.4	0.8	
	Fixed Double Pane	#112	0	0	71	4	0	0	349	9.8	28.1	0.7	
	Inside Storm	#15	0	0	195	12	0	0	969	30.4	31.5	0.6	
		#110	0	0	389	21	0	0	1,900	66.4	35.0	0.6	
	Fixed Double Pane	#15	0	0	216	13	0	0	1,071	39.0	36.6	0.5	Reject
		#110	0	0	422	22	0	0	2,053	87.4	42.7	0.5	
	Moving Double Pane	#112	0	0	369	3	0	0	1,610	71.5	44.6	0.5	
	Reflective Film	#112	0	0	81	11	0	0	471	16.8	35.7	0.5	
12	Heat Recovery	#333	773	896	0	(48)	0	(484)	1,095	30.7	28.2	0.5	Reject
7	Glazing Study Reflective	#15	0	0	244	38	0	0	1,475	67.8	46.1	0.4	Reject
	Film	#110	0	0	507	64	0	0	2,894	150.3	52.1	0.4	
12	Heat Recovery	#323N	7,214	8,367	0	(1,362)	0	(484)	3,826	163.4	42.9	0.4	Reject
7	Glazing Study Moving Double	#15	0	0	114	10	0	0	601	33.3	55.6	0.3	Reject
	Pane	#110	0	0	235	16	0	0	1,186	72.6	61.4	0.3	

Table ES.3 (con't)

Summary of Results and Recommendations - With Synergism, Ranked by SIR

ECO #	ECO Short Title	Discrete Portion	Annual Savings / (Costs or Use) Energy (MBTU) Coal	Wood	Nat. Gas	Elec.	Other	Non-energy ($)	Net ($)	Const. Cost ($1000)	SPB (yrs)	SIR	Recom.
7	Glazing Study Shade Screen	#110	0	0	(29)	35	0	0	275	55.7	>100	0.1	Reject
		#112	0	0	(12)	13	0	0	97	9.9	>100	0.1	
6	EMCS Dehumidifier Control	#551	0	0	0	0	0	170	170	15.5	91.5	0.1	Reject
7	Glazing Study Shade Screen	#15	0	0	(28)	25	0	0	165	30.5	>100	0.0	Reject
5	Extend EMCS Dedicated DTM	#493	0	0	0	0	0	13	13	17.8	>100	0.0	Reject
8	Destratification Fans	#595	1,126	1,306	0	(147)	0	(1,419)	(1)	66.2	N/A	N/A	Reject
		#595	1,118	1,297	0	(147)	0	(1,419)	(21)	66.2	N/A	N/A	
3	Reclaim Waste Oil						-Wst.Oil-						
		#186	0	0	2,885	(22)	(2,885)	(6,512)	(3,474)	18.9	N/A	N/A	
		#638	0	0	1,246	(20)	(1,246)	(4,669)	(3,725)	18.9	N/A	N/A	Reject
		#651	0	0	1,405	(20)	(1,405)	(4,669)	(3,295)	18.9	N/A	N/A	
		#676	0	0	0	(20)	(1,392)	(4,669)	(1,264)	18.9	N/A	N/A	
							-#2 Oil-						
							1,392						

Recommendations

The seven ECO's recommended for implementation in Table ES.3 are developed into projects as shown in Table ES.4. These projects are recommended with the following qualifications.

1. The installation of insulated panels into the window cavities in Buildings 15 and 110 should be done so as to preserve the aesthetics of the existing construction.

2. The installation of two-speed ventilation fan motors in the new robotized paint booths in 323N should wait until the new booths are fully on line, and perhaps should wait until the fan motors need major maintnance or replacement.

3. The extension of the EMCS to Buildings 333 and 312 should be integrated into the system upgrade to 1987 Corps of Engineers specifications. The upgrade is planned for the 1990-1992 period and may result in major changes in the master control room equipment. Modification prior to the upgrade may result in unnecessary expenditure of funds.

Table ES.4

ECO Project Summary

Prgm	Description	Date of Analysis	Bldgs	Constr Cost+ SIOH ($1000)	Construction Year	Construction Cost ($1000)	Annual Energy Savings Fuel Type	(MBTU)	($1000)	SPB	SIR
FEP	Automatic Door Openers	01/87	321 333 345 373 411 493	19.1	7/90	21.2	Coal	547	1.5	1.4	8.5
ECIP	Extend Steam Lines	01/87	468 594 595	508.7	7/90	563.5	NG Elec Coal	47,949 (11) (20,688)	204.7 (0) (56.9)	3.3	7.1
ECIP	Pelletize Waste Paper	01/87	336	2115.5	7/90	2343.0	Elec Coal	(5092) 225,225	(58) 619.4	3.8	3.7
PECIP	Replace Existing Boilers with High Efficiency Units	01/87	186 638 651 676	85.1	7/90	85.1	NG Dist Elec	5101 780 (100)	21.8 4.5 (1.4)	3.2	2.9
FEP	Insulated Panels (Window Retrofit)	01/87	15 110	23.9	7/90	26.6	NG Elec	379 83	1.6 9.5	8.9	2.0
FEP	2-Speed Paint Booth Ventilation Systems	01/87	323N	108.5	7/90	120.5	Elec Coal	852 674	9.7 1.9	9.3	1.5
FEP	Extend the EMCS	01/87	312 333	129.3	7/90	128.6	Elec	1556	17.7	7.2	1.4

The cost effectiveness of implementing the above seven projects is summarized with the following data.

Annual Coal Savings	205,758	MBTU;	$ 565,835
Annual Electric Savings	(2,490)	MBTU;	($ 28,386)
Annual Natural Gas Savings	53,429	MBTU;	$ 228,142
Annual No.2 Oil Savings	780	MBTU;	$ 5,051
Annual Maintenance Costs			($ 31,000)
First Year Cost Savings			$ 739,642
Total Investment Cost			$2,944,693
Simple Payback			4.0 years
Savings to Investment Ratio (SIR)			4.0

Projected Energy Consumption and Utility Costs

The projected annual consumption, cost and reduction by energy type are shown in the table. The pie chart illustrates the magnitudes of energy savings. These data reflect the implementation of the recommended projects, but do not reflect any growth of depot facilities.

	Projected Consumption (MBTU)	Projected Reduction from FY86	Projected Annual Costs ($)
Coal	239,775	48.6 %	$659,381
Electricity	203,095	(1.35) %	$2,315,283
Natural Gas	85,671	38.4 %	$365,815
No.2 Oil	14,570	5.1 %	$83,632
Propane *	2,308	10.4 %	$17,977

* The reduction in propane consumption is not a result of any action taken with respect to this Energy Saving Opportunity Survey. It is the 1987 recorded consumption projected for the future.